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Colonizing peatlands. Transformation or deformation of peat areas in the Netherlands 1000-2000

Karel, Erwin

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COLONIZING PEATLANDS

Transformation or deformation of peat areas in the Netherlands 1000-2000

(Work in progress; please do not quote)

Paper presented at the Conference:

Circulating Natures: Water-Food-Energy
of the European Society for Environmental History (ESEH)

Munich august 20-24 2013

Session:
'Deformation or transition? Quarrying, mining.
land and waters in the Netherlands'
august 23th (Room 1- A15)

Dr. Erwin H. Karel
University of Groningen
(History Department
and
Dutch Agriculture-Historical Institute)

Contact:
University of Groningen
Faculty of Arts, Dept. of History
Kijk in 't Jatstraat 26
9712 EK Groningen

Room: 1312.505
0031(0)503637672
e.h.k.karel@rug.nl

Contents

Abstract

This paper compares the transformation of two so called socio-ecological systems in respectively the west (coastal) and northeast (inland) of the Netherlands. These areas were transformed from peatlands into agriculture land in a time period from the Middle Ages until the beginning of the 20th century. Goal of this study is to get more insight in the relevant topics of a transformation process. This should result in a larger study of the inland system in the future. The paper concludes that original circumstances (low-fen or high moors) were crucial for the type of colonization of the peatlands. Also the rights of ownership (common or individual) influenced the colonization process. The transformation of the socio-ecological system in the west happened in two stages of which the last stage was more or less planned. In the northeast the transformation from peatland to agriculture land was generally spoken controlled. The positive and negative ecological effects of the transformation are obvious, but do not fit in very well the conception of sustainable development.

Introduction

A quote about the Low Countries of the Roman writer Gaius Plinius Secundus (23-79 AD), better known as Pliny the Elder, is often cited in Dutch literature. He stated in his *Naturalis Historia* that the Frisian population, called Chauci, were lucky to become slaves of Rome, because they had lived under such miserable conditions:

> 'I myself have personally witnessed the condition of the Chauci, both the Greater and the Lesser, situate in the regions of the far North. In those climates a vast tract of land, invaded twice each day and night by the overflowing waves of the ocean, opens a question that is eternally proposed to us by Nature, whether these regions are to be looked upon as belonging to the land, or whether as forming a portion of the sea?'[1]

The Low Countries are a typically delta-area. Some of the major European rivers (Rhine, Maas/Meuse) flow in this delta into the North Sea. About 30% of the Netherlands lies beneath sea level and these areas are wetlands. Until the Middle Ages these wetlands stood in an open connection with the sea. This explains the remarks of Pliny the Elder.

From the Middle Ages on, the inhabitants started to build dikes and other forms of protection against the water. At the end of this period they even drained substantial parts into agricultural land (the so called 'polders'). In ecological sense a radical transformation[2] of the landscape by human hand took place in the period from roughly 1250 to 1900. One can even argue that during this period transformation of landscape became an inalienable part of the Dutch culture. Even in the 20th and 21th centuries radical change of (parts) of the landscape were common events, for example as can be seen in the effects of the land consolidations between 1954 and 1980, which enclosed nearly 75% of rural Netherlands (Andela 2000; Van den Bergh 2004), the drainage of large parts of the *IJsselmeer* from 1930 to 1950 (Van der Heide 1965) or the rebuilding of nature reserves today.

In ecological terms radical transformations of landscape by human hand are often presumed to be deformations and hence an unsustainable management of nature. But from a historical point of view this is less evident. Historians tend to look also to the benefits for a society when an ecological environment is transformed. Changing wilderness into agricultural land is not necessarily a deformation of landscape, but can be also seen as a form of sustainable

[1] The Natural History. Pliny the Elder. John Bostock, M.D., F.R.S. H.T. Riley, Esq., B.A. London. Taylor and Francis, Red Lion Court, Fleet Street. 1855., Plin. Nat. 16.1

[2] I use the terms transition and transformation as equivalent

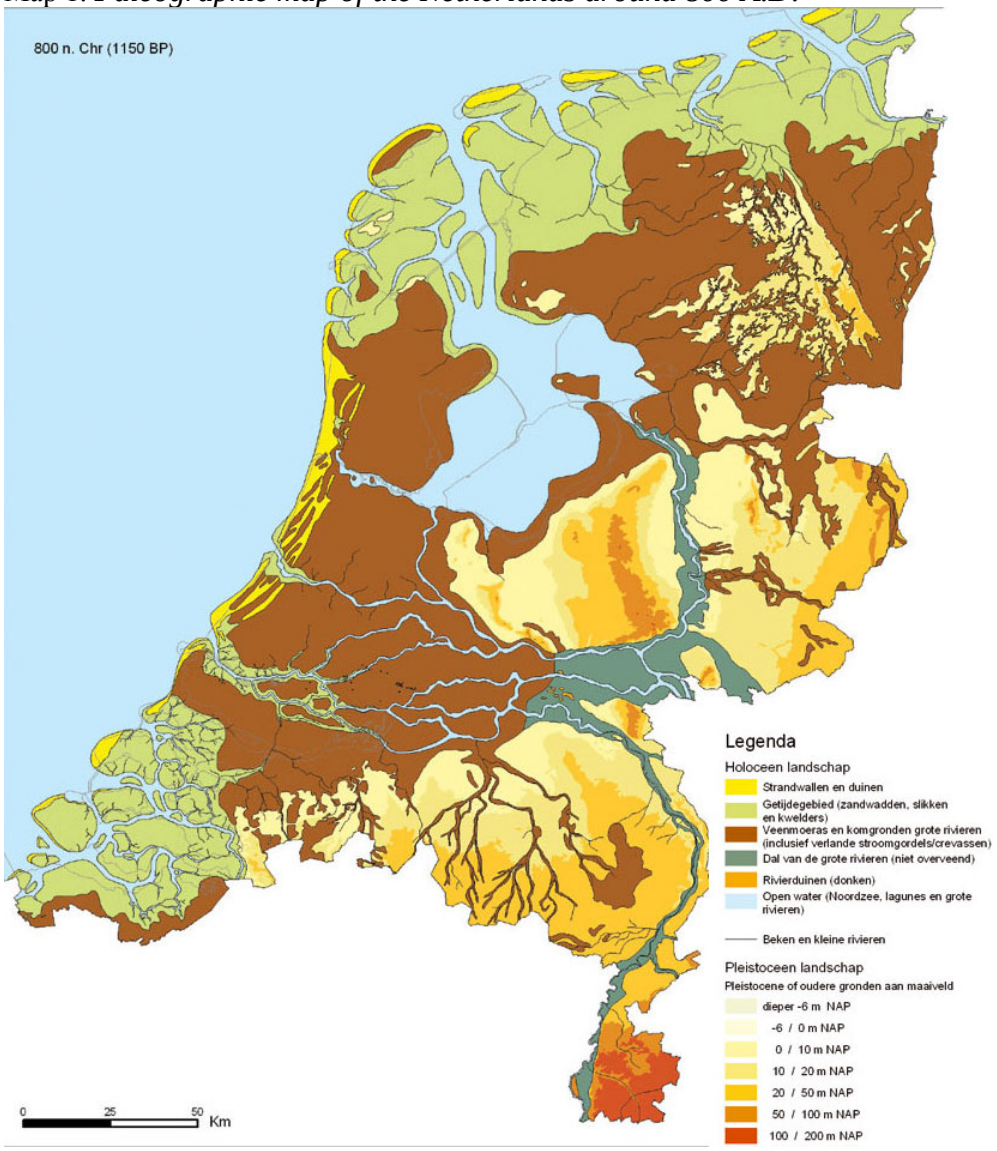
development. Although the original biotopes are destroyed, new ones are created which are more suitable for human demands. There is no doubt that this fit into the definition for sustainable development of the Brundtland-commission, which can be summarized as 'the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. (Brundtland-commission 1987). Of course the concept of sustainable development is not generally accepted among historians as a useful instrument to analyze the past (see f.e. Radkau 2000). Sustainable *development* is too much a political-ideological concept from the present. Its starting point is a global world which is threatened by an ecological disaster. Such a concept cannot be used without problems in the past. On the other hand, using sustainable without development, as Radkau seem to prefer, narrows the analytical possibilities. Sustainable alone leaves less room for transformation, because it presumes the maintenance of the existing. I am inclined to use *sustainable development*, as defined by the Brundtland-commission, in historical situations, but only if it can be translated into the mental conceptions of the people living in that situation.

One of the interesting directions in environmental studies is the development of the concept of socio-ecological systems. (see f.e. Janssen 2006) The concept emphasis resilience of socio-ecological systems, in other words studies in socio-ecological systems try to understand how these systems cope with change and perturbations. (Janssen 200, 128). As the term already suggests the interplay between and mixing of ecological and social system is essential. This makes the concept very useful for historians, also because it gives room for dynamic developments. Walker et al (2006) proposed that transformation of a socio-ecological system is one of the options. 'Transformability is the capacity to create a fundamentally new system when the existing system is untenable' (Walker 2006). Transformations by human hand or through disasters, requires the development of a new system, or a new way of 'making a living'. This should not be understood as an 'ecological determinism' but as the result of interaction of nature and human. The concept of socio-ecological transformations might give better insight in the Dutch developments. Van Dam (1998) already showed that the transformations in landscape of the Low Countries during the late Middle Ages, often interpreted as a deformation, created new opportunities for the inhabitants of the wetlands.

The radical transformation from wetlands into agriculture land has been performed many times in the Netherlands during the last 1000 years. In this paper I will concentrate on one specific form of wetlands, namely bogs that were used to dig peat. Around 1000 A.D. these

bogs still formed a substantial part of the Netherlands. Today only 1% of them still exist. Most were transformed into regular agriculture land. These transformations were part of the social-economic development of the Netherlands. Turf was an important source of energy and peatlands could be cultivated into agriculture land. There have been many different forms of transformations, mostly determined by the local conditions. However, in this paper I will distinguish two types of transformation: in the western part of the Netherlands (to which we will refer as the coastal socio-ecological system) and in the northeastern part (the inland socio-ecological system). The last one is very comparable to other transformations in the southern Netherlands and will be used as a representative example. Today the coastal socio-ecological system is an urbanized polder landscape, while in the northeastern system the rural, agricultural society dominates.

Map 1. *Paleographic map of the Netherlands around 800 A.D.*



The light areas along the coast are wetlands. The dark areas are peatlands.

During the last decades I did several studies about the peat areas in the northeastern Netherlands, mostly with a social or economic theme. I intend to develop a new project this time from a socio-ecological perspective. In this paper/preparatory study a comparison between the transformations in the coastal and inland socio-ecological systems is made. This should clarify whether there are historical patterns in this kind of transformations. What were the differences in transformations of both socio-economic systems? Under what social-economic conditions these transformations took place. What were the long term ecological effects? How to judge these in the light of sustainable development (even though this is disputable)? The goal of this comparison is to develop a research plan for only the northeastern part. However, the differences between both areas should enlighten what themes could be relevant for such a plan.

Literature on peat areas is quit extensive. Today many books are published on the actual developments of these areas. This is among others stimulated by the International Peat Society (IPS), a society of entrepreneurs, scientists and other interested parties.[3] In a few countries, like the Netherlands, there are also a substantial number of books on the history of the peatlands, often concerning the social and economic development of those areas. In the Netherlands there are few books from an environmental perspective. One exception is the work of Petra van Dam and in so far water management is concerned recently the work of Tim Soens. Both do concentrate on the coastal socio-ecological system. I used their work intensively. For the northeastern socio-ecological system, there is no such literature. The main work on peat digging written about this area is of Michiel Gerding. His work deals mainly with economic aspects of peat. I combined this with my own studies to sketch the inland socio-ecological system.
First I will give the most important functions of the peatlands. Next I will give an overview of the historical developments in the coastal and inland socio-ecological systems in two separate sections. Then I will conclude with a comparison of specific issues like the origin of the peatlands, the colonization, the commons and the type of transformation.
I emphasize that this paper is work in progress. I am still working on an outline for a research plan. Comments and suggestions are very welcome.

Peatlands

Bogs do have several functions in a socio-ecological system. They often seemed to be useless areas in the eyes of non-locals, but for farmers and entrepreneurs they created economic opportunities. In some countries – the Netherlands and Ireland are very good examples – bogs were important suppliers of energy. If peat is dried in the correct way (turf), it can be used as fuel. In the Netherlands it was already well known during the Roman Empire. Pliny

[3] http://www.peatsociety.org/; see also http://www.fao.org/docrep/x5872e/x5872e00.htm#Contents

noted about the Chauci: "… they fashion the mud, too, with their hands, and drying it by the help of the winds more than of the sun, cook their food by its aid, and so warm their entrails, frozen as they are by the northern blasts".[4] The lack of wood and other means of fuel, made turf the most logic alternative for warming and cooking. But the exploitation of peatlands had a large influence on the development of the landscape and the water management. In the 19th century peat was also use for other reasons. As peat dust is was used in stables, for example by the horse tram owners in large cities. (Karel 1997-1, 44-48) Some factories produced active carbon from turf, to use for purification of air and water, or medical purposes. (Karel 1997-3, 135)

Besides cutting turf, peatlands played a role in the agricultural systems. The soil is relatively infertile, because of the low pH-values. But these values can differ locally. So in some areas agriculture on top of the peat soil is more suitable than elsewhere. Low fen (pH 6-9) is more suitable than high moors (pH <5.5). In the latter only a few products (mostly potatoes and buckwheat) can grow, but only by using slash-and-burn agriculture. Farmers living nearby the bogs used parts of these peatlands for harvesting hay and in the summer sometimes as pasture land for their cattle. If the peat in high moors is totally removed and the sandy soil beneath the peat is cultivated with fertilizers, new agriculture land can be created. Alternatively, like in Emsland (Germany) after the Second World War, the sandy soil is ploughed from two meters under the surface above the peat layer. Already in the twenties of the 20th century peat was also used as soil for gardens. The boom in building garden cities probably stimulated this use. In the fifties of the 20th century Dutch soil scientist developed a method (freezing peat) to improve the quality of this soil for horticulture. From that time it was also sought-after for greenhouses. (Karel 1997-2, 96) Moor lands were waste lands, by farmers often used for harvesting by-products. They were for example used to find fen-berries (*Vaccinium oxycoccos).* Peatlands also played a minor role as shooting-grounds.

The third function of bogs is military. Moors are used as defense system against invaders. Crossing a moor is for heavy armed armies nearly impossible. Roman soldiers already build wooden bridges through the moors to pass their army, but sometimes even older *knuppelpaden* are discovered. During the time of the Dutch Republic (16th to 18th centuries)

[4] The Natural History. Pliny the Elder. John Bostock, M.D., F.R.S. H.T. Riley, Esq., B.A. London. Taylor and Francis, Red Lion Court, Fleet Street. 1855., Plin. Nat. 16.1

the peatlands in the east of the Netherlands were used against invaders. Often sconces (*Bourtange, Nieuweschans*) were built on the sand path through the moor. In this case not the transformation of the landscape was essential, but its maintenance. In fact, it was forbidden for farmers to colonize these moors along the German border before 1800. (Karel 2000) In the 19th century these regulations were abolished, to open up these peatlands for large scale turf exploitation.

Finally one can presume that the moors were part of the mental conception of people. We know for example that prehistoric people used moors for ritual purposes (Van der Sanden 1990). In legends, myths and saga the bogs are sometimes mentioned, mostly as a frightening area were *dwaallichten* (fen-fires) and *witte wieven* (Banshees) lived. Although local farmers used the bogs if possible, they also seem to exclude it at the same time from their social environment.

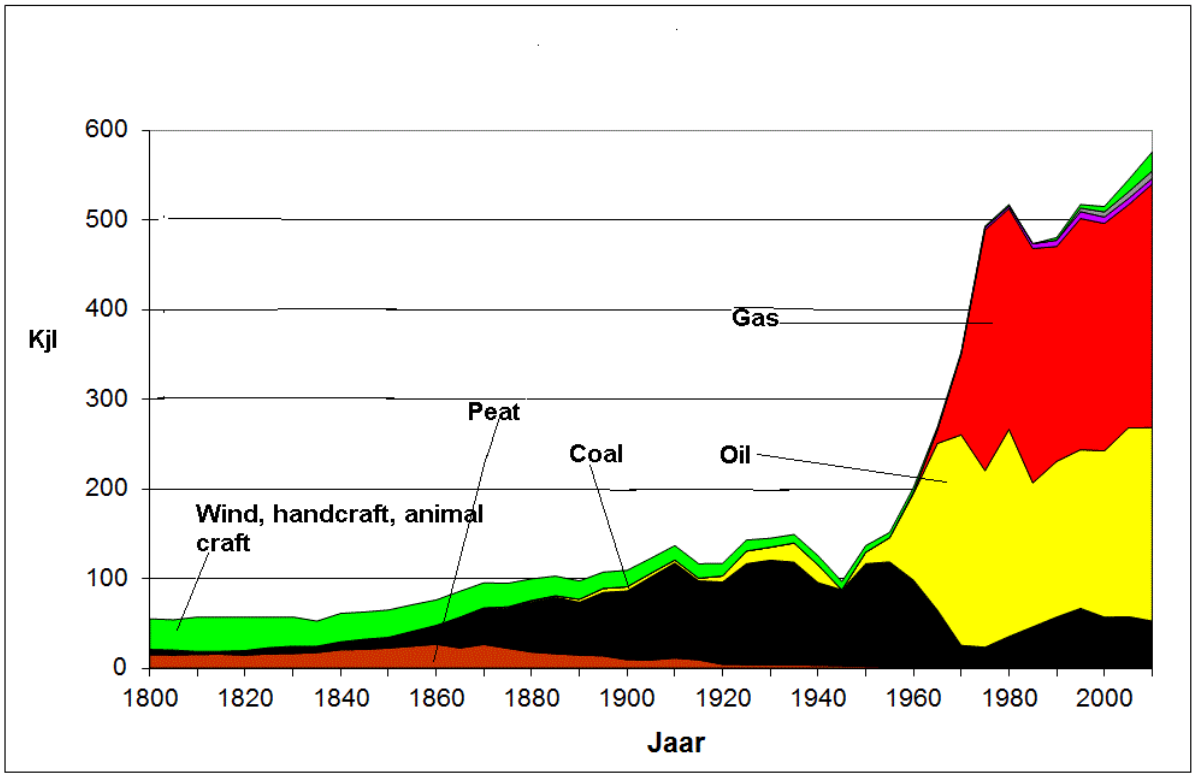
For foreigners these areas looked inaccessible. The 17th century's mapmaker Cornelis Pijnacker described parts of the moors in the northeast Netherlands as 'desertum in acceβum' (Karel 2000). But, as we have mentioned before, the bogs were often part of the agricultural system of the local farmers.

The conception of the moors changed. Under influence of physiocrats (French economist who believed that the wealth of the nations could only be derived from agricultural land) these peatlands were considered to be waste land which should be cultivated. But already at the end of the 19th century, when peatlands were in danger to disappear, conservationist started to protect some of these areas. Het *Naardermeer*, partly a bog biotope, became in 1906 the first nature reserve in the Netherlands. (Gorter 1986; Van der Windt 1995). Today several bogs are preserved. It is clear that over the time the conception of bogs changed from a hostile environment, via an exploitable environment to a fostered environment. Of course, further research on this topic, should make the necessary differentiation.

Generally spoken, in the Netherlands the use of peatlands as source of energy was without a doubt the main reason for the transformation in new (agricultural) landscapes. Before 1850 peat was next to renewable energy forms (wind, sun, timber, animal- and human power) the most important form of energy in the Netherlands, although there is a discussion how important. De Zeeuw (1978) raised the question whether the prosperity during the Dutch Golden Age (16th and 17th century) was also determined by the use of turf. De Zeeuw had no exact figures, so he made some estimation. He concluded that without turf the Dutch society would not have reached the high level of prosperity. His conclusions were criticized by

several authors (Unger, 1984; Davids; Van Zanden, 1997), but more or less confirmed by Gerding's study (Gerding 1995, 357). Unger for example assumed a much lower consumption of energy then De Zeeuw. And Van Zanden stated that the efficient use of wind energy was more important than turf. Recently Cornelisse calculated for the 15th and 16th century a consumption of 11,9-16,7 gigajoules per capita. (Cornelisse 2008, 270)Although this is less than De Zeeuw claimed before, it is still evident that turf was the cheapest and most important source of energy for Holland.

Figure 1. Estimated use of energy per capita in the Netherlands (1800-200)

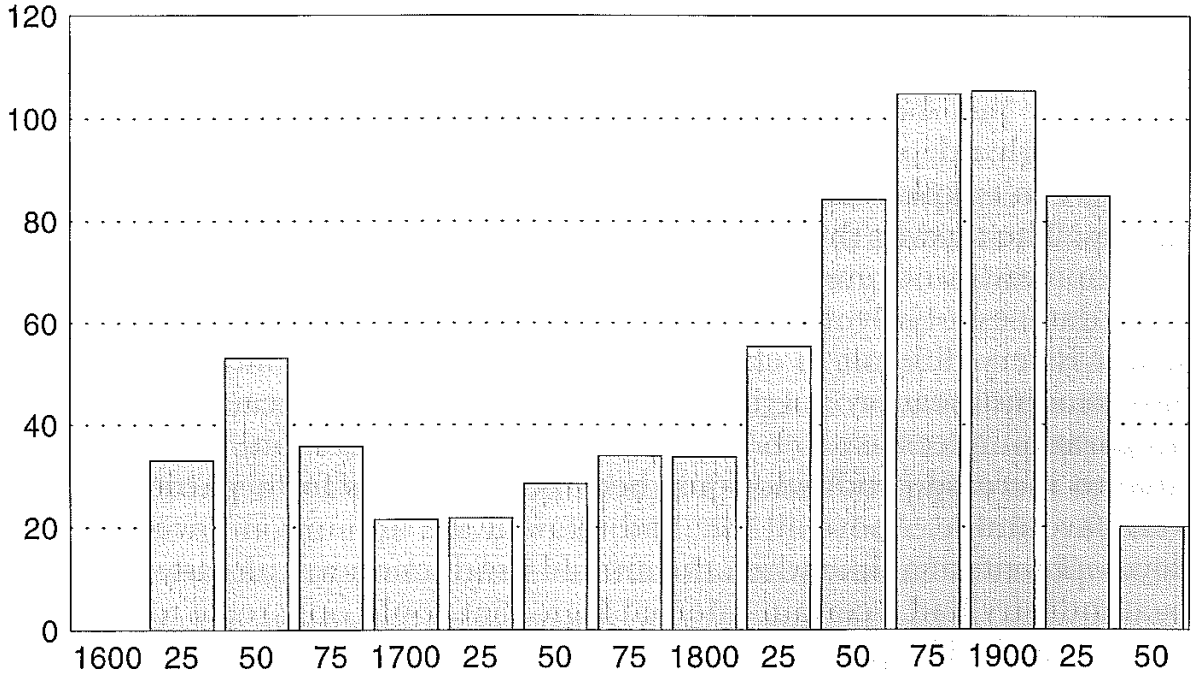


Source: http://www.deconsult.nl/fr_en_transitie.htm (based on data CBS)

One can also presume that cutting turf must have been cheaper than importing coal. Some authors claim that the wide spread system of peat digging hindered the development of new technologies. (Mokyr 2000), and thus slowed down the Industrial Revolution in the Netherlands. I will not enter into this discussion. In this paper it will suffice to conclude that the use of peat was inevitable for the development of the Dutch economy before 1850.

In the second half of the 19th century coal became rapidly more important. The Industrial revolution caused a substantial increase in the use of fossil energy. At the same time peat digging (in volume) reached its peak in the second half of the 19th century.

Figure 2. *Estimates for peat production in the Northern Netherlands 1600-1950 in* dagwerken



Source: M. Gerding, *Vier eeuwen turfwinning* (Wageningen 1995), 365.

Gerding (1995, 365) estimated the peat production in the northern Netherlands in so called *dagwerken* (the amount of turf a workman could produce in one day). The first peak was in the 17th century during the heydays of the Dutch Golden Age. The second was around 1900. Peat was then still used in some factories like brickworks, But it was less efficient than coal (coal has about four times as much calories).

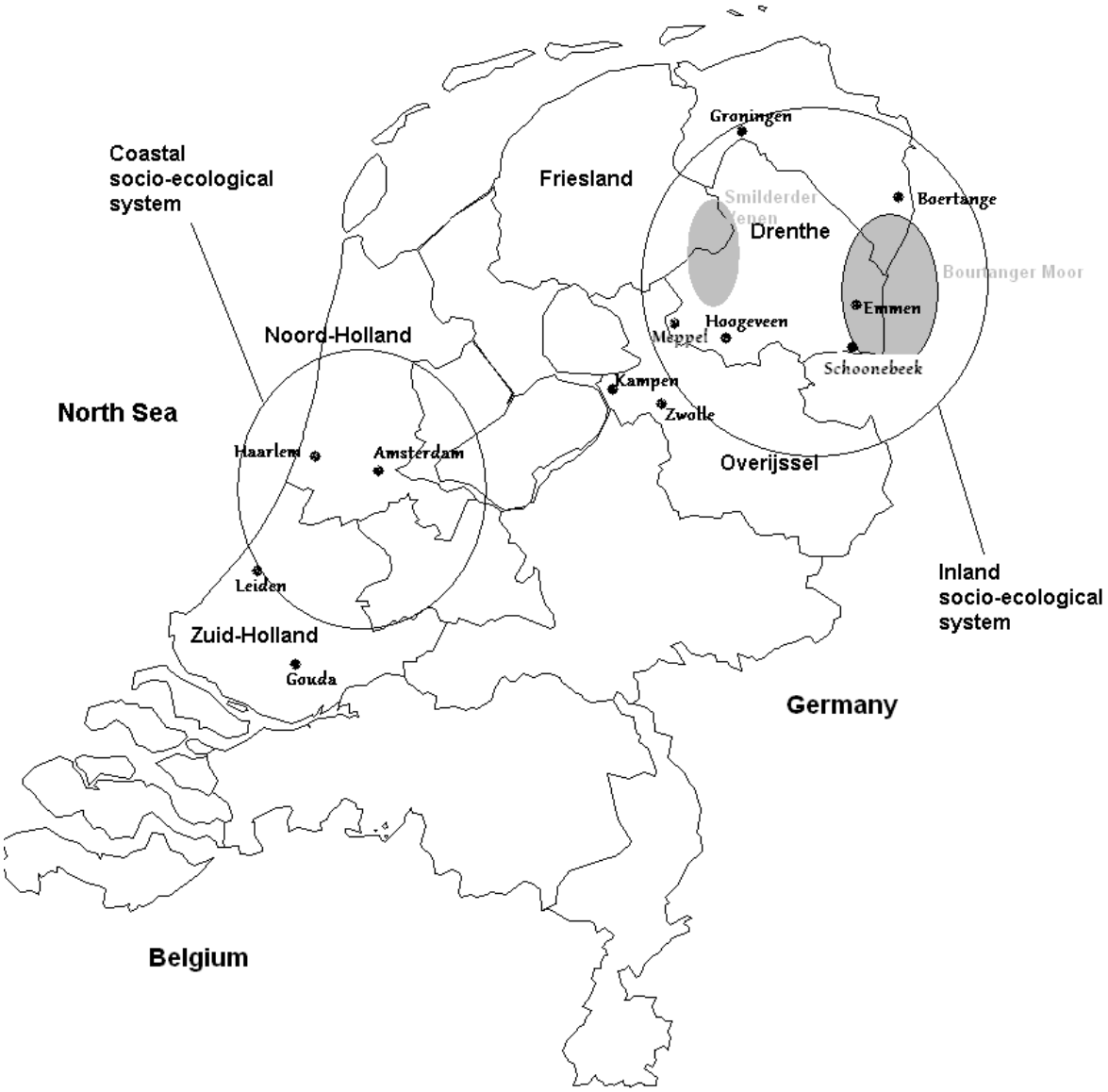
Around 1900 the role of peat as supplier of energy was played out, but turf cutting went on until 1970. It had changed the landscape radically. Bogs do have a typical biological system of which most elements cannot exist outside this kind of biotope. Peat digging done at the scale as in the Netherlands can only lead to the destruction of these biotopes. On the other hand it created also new nature. Is it possible to speak of a sustainable development if you look from within the socio-ecological system?

Development of the coastal socio-ecological system

Both socio-ecological systems, the coastal and the inland, originated in different ecological circumstances. In the west the peat grew under influence of transgressions and regressions of the sea. The western peat (and also along the eastern coast of the former *Zuiderzee*) is often called 'laagveen' (low fen), while the northeastern is denoted as 'hoogveen' (high moor peat). This indicates the way peat developed, namely respectively above or below the water level. However, recent research proved that in the west also locally high moors grew. (Van Ven 2006) This shows the complexity of the coastal socio-economic system. The geographical demarcation is not easy. Further to the south wetlands dominated, but here as well many areas were low fen. The same can be said about the northern part that stretches into Germany. However, in this paper I will limit to the center of this area (large parts of the present provinces of *Noord-Holland* and *Zuid-Holland*). Actually the soil in the west was a mixture of low fen, flooded land and sea clay it is more fitted for agricultural cultivation than the high moor peatlands in the northeast.
Besides the rural areas, a number of cities (Amsterdam, Leiden, Haarlem, and Gouda) became after the colonizing important for the development of the socio-ecological system.

Van Dam (1998, 26-32) distinguishes four periods in the socio-ecological transition of the coastal system. Until 1000 A.D., the cultivation of the area took place from the sand ridge at the borders. In the period from 1000 until 1350 A.D. people started to colonize the peatlands. On drained land they cultivated among others grain. Most of the uncultivated area was in possession of the Bishops of Utrecht. After 1250 the bishops started to sell the land, instead of renting it out. One can presume that this has speeded up the colonization process. Most colonists tried to find a living as farmer. This individual colonization could only be sustained as long as the farmers kept their land dry. Cooperation and regulation was therefore needed. However, the drainage had its consequences in the long run. If peatland (actually the soil is not decayed plant material) is dried the oxidation process starts again. So the land is bedded down, which already was processed by the drainage itself. Further drainage is necessary to keep the land sufficient dry as farming land. The lower the land, the less it is useful as arable land. For a short time it can be used as pasture for the cattle, but once it lies beneath the water level it is no longer useful. Large areas changed into lakes, which was accelerated by caving in of land because the maintenance of dikes came to a dead end. In the third period, from 1350 to 1550, a deformation of the landscape (from an agricultural point of view) took place.

Map 2. *Map of the Netherlands*



This process we can see as the *first* transformation of the socio-ecological system. Around 1350 the ecological system allowed only on a limited scale the cultivation of arable land. This process has often been seen, as noted before, as the deformation of the land. From an agricultural point of view this is certainly true, but this cannot be affirmed from an ecological or a social-economical perspective. Van Dam emphasis, that the transformation to another ecosystem also changed the socio-economic environment because it created new opportunities. The inhabitants adapted their way of living. Peat digging, fishing, in some areas salt extraction, and above all trade became important sources of income. The new economic development after 1350 was for certain favored by the rise of the Flemish cities. Amsterdam developed in the 15th and 16th century as an important regional city of merchants.

It became the bridge between the Baltic trade and the Mediterranean. In the 17th century Amsterdam further developed to the world's most important financial and trade center. (De Vries and Van der Woude, 1997)

The technique used in peat digging was in both socio-ecological systems different. Because in the west the peat lied beneath the water level it had to be dredged. Peat diggers used a kind of scoop to pull the peat form the water. With their boats they moved it to fields to dry the peat. And after that the peat brocks were transported to nearby cities. This techniques favored small-scaled enterprises, this in contrast to the large-scale companies that developed in the 16th and 17th century in the northeast. But also this small-scaled exploitation was not without ecological consequences. Peat digging stimulated the growth of wetlands and lakes further, because the ground level lowered.

The colonization, the cultivation and even the peat-digging and fishery stimulated however the development of so called *waterschappen* (water boards). (Soens 2013, Van Tielhof 2006) This more or less typically Dutch form of cooperation protected the land of the individual farmers/citizens within a district, i.e. water management by building dams, sluices and management of banks and shores. It developed in the coastal socio-ecological system from the Middle Ages on. However, in the northeastern system water boards were less common (but not totally absent) until the 19th century. These institutions played an important role in the transitions of the coastal socio-ecological system. They were one of the two pillars (the other is capital of rich merchants from the cities) that created the second ecological transformation in this area.

Around 1550 a new transformation started: reclaiming land (*impoldering*). In 1550 large parts of Holland were lakes. Some of them were already reclaimed, but in 1597 the first very large lake was impolderd, namely the *Zijpe- and Hazepolder* 6775 hectares large. The reclaimed land was very useful as agriculture land. It was most fitted for cattle grazing, less as arable land. Around the cities specialized farms developed at which milk, butter and cheese was produced for the cities. Cattle (for meat) were brought in from north-Germany and Denmark. In the pastures the animals were fatted up. Grain was imported from the Baltic. The coastal area was all but self-supporting. When the turf became scarce, even the energy had to be imported from elsewhere in the Dutch Republic.

The impoldering changed the landscape more radically then the first transition. The old biotopes could not survive in the drained land. The new land or *polderlandscape* is a man-

made-landscape that covered all of the province of Holland. It developed into a unique biotope during the past centuries. (Borger 1997) Reclaiming land in the west ended in the 19th century when the last large lake (Haarlemmermeer, 1837- 1855) became a polder and was colonized.

The urbanization became one of the important characteristic of this socio-ecological system. Already in the 17th century half of the population lived in cities.(Devos e.a. 2011, 161). The Industrial Revolution stimulated this process; around 1970 67% of the people live in urban settlements. (Karel 2011, 190)

At least three points should be highlighted. Obviously there are two transformations in the west. The first occurred as a consequence of the colonization of this area. Drainage and later also the peat digging caused a lowering of the ground level. This limited the agricultural activities in the area. The population pressure shifted from the rural to the urban settlements, were new forms of income developed. The second transformation took place from 1600 until 1900 by the impoldering of wetlands. While the first one was the unforeseen consequence of human activity, the second one was more or less well planned. Creation of agriculture land was the main goal.

Another point to note is that the exploitation and colonization was mostly a private initiative. There were no commons, although farmers had to work together to keep the agriculture land dry. The creation of water boards as an institutional framework was a precondition for the second transition.

Finally, a third point is that the socio-ecological system in economic sense was depended from imports. The land did not give sufficient means for living. Agriculture products had to be imported form the Baltic area and the eastern Netherlands. And also turf had to come from the eastern Netherlands.

Development of the inland socio-ecological system

The major peatlands in the northeastern part developed alongside an old lateral moraine. Here the sphagnum (moss) grew undisturbed for nearly 8000 years. At some places the peat layer reached up to 10 meters. Center of this inland socio-ecological system was the *Bourtanger Moor*, a high moor which stretches into Germany. Gerding (1995) includes nearly all bogs in the provinces of Friesland, Groningen, Drenthe and Overijssel in this socio-ecological system. High moors were most common, but in some areas also low-fen existed. Were in the west several cities played a role, in the north few cities dominated the socio-ecological

system. In the south Zwolle and to a lesser degree Meppel and Kampen were of regional importance. However, most important was the city of Groningen in the north.[5] The city had the staple rights in trade of turf for this area and was also very active in stimulating peat digging. That is why it build a canal (*Stadskanaal*) that opened up the northen part of this socio-ecological system. The city thus became a large-scale *vervener* (entrepreneur in peat digging). Besides the consumption in the city itself, most of the turf was exported to the west Netherlands.

The social-ecological system stretches across the borders of what is now the Netherlands and Germany (i.e. during the Middele Ages the Bishop of Münster and the Bishop of Utrecht). For a long time there were many disputes between the villages (*marken*) about the exact trace of the borders, but in the end most of these disputes where settled in the 18th and early 19th centuries. (Karel 2000). But the socio-ecological system on both sides developed quit different. The bishop of Münster owned the uncultivated high moors on the 'German' side. He divided large parts of the bogs up among former soldiers who tried to make a living as small farmers. Thus, on this side of the border the agricultural development of the ecosystem was most important. The land was used, among others, for the cultivation of buckwheat, a crop that did well on the rather unfertile soil. However, success was only guaranteed by a slash-and-burn agriculture.

On the Dutch side of the border the turf cutting was more important. The peatlands became however not before 1600 of major interest. There are no indications that the high moors were colonized in the Middle Ages (Spek 2004). Some local farmers integrated the moorland into their agriculture systems, because parts of it were suitable to graze the cattle in the summer or to find hay for the winter. But they also could use it to cut turf and after the peat disappeared to transfer it into agricultural land. Villages that developed form these kinds of agriculture are called *randveenontginningen* (cultivations at the border of peatlands). *Randveenontginningen* can be found in the whole inland socio-ecological system, but *Schoonebeek* is an excellent example. These settlements are comparable to the first cultivations in the coastal socio-ecological system. Probably it was stimulated by increase of the population of the existing villages, which forced the inhabitants to cultivate more land. In the west these cultivations at

[5] Interestingly enough the city of Groningen lies in two socio-ecological system. (See for social differences between two systems Paping and Karel 2011, 49-54). On the one hand is integrated in the inland system we discus here. On the other hand it is also part of the extended coastal system as discussed above. Because the system and not the city is the starting point in this paper, this double role is not relevant.

the edge of the bogs developed into a colonization movement, but in the northeast it did not. It is true that smallholders in the northeast harvested buckwheat on the peatlands in the 17th and 18th centuries, but this never was practiced at a large scale and seldom in permanent settlements.

In the Dutch part the high moorlands were property of the farmers in the villages. Often they were common property. In some cases parts of (the pastures in) the high moors at the border Emsland-Drenthe were even in use by several villages. These *compascuum* existed until 1817. The fact that many peatlands were in common use, made it for investors easier to get hold on large parts. When at the end of the 16th century the peat reserves in the west became low, rich merchants started to buy large parts of high moorland in the east. The *Hollandse Compagnie* for example bought about 50% of the *Leggelder en Diever Smildeveen* (peatlands in the west of Drenthe). (Gerding 1995, 201-207). Local entrepreneurs also started to invest in turf. Not only the city of Groningen, but also Frisian investors and nobility in Drenthe, f.e. Roelof van Echten who with help from merchants from Leiden founded the *Algemene Compagnie van de 5000 Morgen* in Hoogeveen (Gerding 1995, 227-228).

The technique of turf cutting in the high moors differed totally from those in the low-fens in the west. A large canal was build, which had several side canals into the peatlands. This system of canals not only drained the land, but also was used to transport the turf. Peat workers cut the turf, dried it and loaded it on ships. Most of it was transported to cities in the west. This technique allowed large-scale peat exploitation. Ecological more or less the same transformation took place as in the second transformation in the coastal area, namely the development to agricultural land. But the sandy soil beneath the high moors had to be cultivated before it was fertile enough to use as agricultural land. Before the end of the 19th century this was a problem, because there were no artificial fertilizers. Groningen solved the problem by selling its town manure to the peat colonies. In Drenthe the local government issued decrees which obliged *verveners* to use the top peat soil to cultivate the sand soil. Especially this proves that the transformation was a planned activity rather than an uncontrolled depletion of mineral resources. This does not alter the fact that occasionally peatlands were left in half cultivated conditions by *verveners* who run out of financial means.

Around 1850 the last large peat area (east Drenthe) was opened up. It happened before the Industrial Revolution had his real take-off in the Netherlands (1870-1890). *Verveners* probably calculated enough profit. Besides, in the 19th century fysiocratism still had some

influence (although this should not be overestimated in the Netherlands). The urge to cultivate waste lands was thus strong. In the period 1852-1863 two large canals (*Oranjekanaal*/48 kilometers and *Verlengde Hoogveensche Vaart*/33 kilometers) were built by local government and private investors. The high investments (also in bridges, sluices, locks and so on) prevented the option of a reverse in a later phase. Peat digging became less profitable from the end of the nineteenth century. Coal, first from the German *Ruhrgebiet* later on also from Dutch mines, replaced peat as most important source for energy. Gerding (1995, 365) estimated that the production of turf reached its top during the period 1875-1900. (see figure 2.) But already in this period turf provided only a fraction of the totally consumed energy (see figure 1). The process of industrialization caused without doubt the top production at the end of the nineteenth century, but coal was a much more efficient provider of fuel and already before 1870 its market share outnumbered turf. *Verveners* lost first their markets in the west and then their local markets in the east shrunk as well. After a very short revival during the First Wold War, peat as energy source was no longer meaningful. In the second quarter of the 20th century the production collapsed. Remarkably enough, the peat digging (after the Second World War in mechanized form) went on. The mean reason was that the profitable part lied beneath the peat layers. Once the peat disappeared the soil could me made suitable for agriculture. In a sense there was no other option for the owners of the peat than to progress. However, in the 1950's a Dutch laboratory developed a technique to make peat useful as soil in gardens and horticulture. Since then the exploitation of peat all over the world shifted towards this utilization. Important areas to harvest peat are found in Finland, Ireland and Russia. In the inland socio-ecological system the peat cutting ended officially in the 1970's. (Karel 1997-2, 96-99)

The peat digging had not only influence on the ecological system, but it also changed social system in those area were the turf cutting took place. The core area (Drenthe) was before the large exploitations mainly populated by farmers and peasants, who lived in small villages on sandy soil. In the beginning peat workers visited the peatlands only in the digging season, but they tended to 'permanent' settlements, i.e. they migrated with peat digging projects further eastward. The ground they left was taken up by farmers, who lived in villages (sometimes up to 11 kilometers long) along the canals. In the beginning of the 20th century the national border in the east was reached. At the same time the crisis in peat digging started. Roughly 6000 peat workers ended up in the area around *Emmen*. In this inner-colonization, like earlier in *Hoogeveen,* the composition of the population differed totally from elsewhere in Drenthe.

Peat workers, who were after the Second World War retrained into factory workers, dominated the area. *Emmen* and *Hoogeveen* are today urbanized enclaves in a rural world.

Ecological the peatlands were turned into rather monotonous open agriculture landscape. Farmers are strongly orientated on the agricultural industry (potato flour and sugar). This contrasted highly with the small-scaled (until the land consolidations, 1954-1980) on the old sandy areas.

Following points I want to highlight. First, in the inland transformation of the peatlands the commons played an important role. It made it easier for companies to buy large peatlands and exploit these on a large scale. The turfs were transported to the west and only few were used for local demands. Economically the socio-ecological system (with exception of the urbanized areas) lied in the periphery of the coastal system. For merchants for the cities in the west, the investment in peatland was a long term investment. In a time that turf seemed to be the only logical form of bulk energy, this must have been a safe investment. The transformation of the extensive bogs in the northeast was a much more planned activity than in the west. After 1600 the experience and the financial capital existed to exploit large peatlands. Local governments were well aware that cultivating the land after the end of the peat digging stage demanded several preconditions. Via regulations they enforced the owners of peatland to respect these conditions. The transformation from peatland to agricultural land was thus not uncontrolled, but a deliberated action.
Ecological another landscape developed than in the west. This was due to the different preconditions of the peatlands (low-fen as distinct from high moor), but also the more systematic exploitation of the bogs.

Conclusion: two systems compared

What were the differences in transformations? Under what socio-economic conditions these transformations took place? And what were the long term ecological effects?

We split the answer in five parts:

1. The different conditions in which peatlands originated
2. The different types of colonization
3. The form of the commons
4. The character of the transformations
5. The long term ecological effects

The socio-ecological systems in the west and east originated clearly under different conditions. This influenced the character of the bogs. Low-fen is more useable as agriculture land than high moors. Besides in the west the influence of the sea was very important. It forced the inhabitants of the coastal system to institutionalize (water boards) their protection, which certainly had effects on the ecological system. It is also clear that within the socio-ecological systems, the local conditions widely vary. These conditions effected in the end the type of colonization.

In the beginning the colonization of the bogs showed similarities. In both systems the cultivation started from the edge. But in the west the cultivation developed relatively soon into an inner colonization of farmers. The preconditions in the high moor were not good enough for an intensive colonization in the northeast. In this way other colonization patterns developed in both areas, although also these differed from place to place within the socio-ecological systems. Peat workers played in first instance an important role in the colonization in the inland system. In both systems however the farmers were the final group that cultivated the new land.

The peatlands in the northeast were often commons. They could be sold in large parts, which made a planned exploitation more possible than in the west, were small pieces of land were handed over to individual farmers. In the latter case cooperation (for example building dykes) was essential to keep the land from flooding. This kind of cooperation formed the base for reclaiming land after 1500.

Moorlands are not a very suitable environment for human (i.e. farming) activities. Only a radical transformation (or transition) of the land could make it useful. One can argue that the increase of the population stimulated the transformation into agricultural land. This is a certain degree the case in the west en east during the Middle Ages, but in the period 1600-1800 population pressure was low in the Dutch Republic.
It is interesting to see that the transformation in the west happened in two stages. In the past this first stages was often considered as a deformation of the land, but today we look at it as a transformation that created new opportunities. It changed the socio-economic basis of the inhabitants and created new ways of gaining incomes.

One can be very brief about the long term ecological effects: human interference was (and is) responsible for the transformations of the moorlands into cultivated land. Most of the original flora and fauna of these wetlands disappeared, because it was very specific for this

type of landscape. Today in a few areas the moorlands are preserved or even rebuild, but this is only a small percentages of the original area.

Is it possible to say anything about sustainable development? Nature today is much more profitable for human beings than it was in the past, and as we have seen in both systems it was in the end a planned activity. On the other hand, and that is certainly true for the inland system, biodiversity is affected severely. The monotonous agriculture landscape, which is worsened by the land consolidation and modernization of the agriculture sector after the Second World War (Karel, 2013, 155-183), is certainly a degradation of nature. Obviously, sustainable development is not a very effective instrument to judge the past.

Further research

The focus of the follow up research will be the transformation of the inland socio-ecological system in the northeast. This comparative preparatory study should give more insight in which themes are important for such a research project. I will mention a few points, without claiming to be exhaustive.

1. A better differentiation of areas within the socio-ecological system seemed to be necessary. In a comparative study between the inland and coastal area a broad distinction can be useful, but when focused on a more detail level in a system one has to become more specif. The difference in time between for example the turf cutting in the *Smildervenen* (west Drenthe, 17th and 18th centuries) and the *Bourtanger Moor* (east Drenthe, mainly after 1850) is to big. In the latter case other economic and social developments played a role, like the Industrial Revolution and new forms of colonization. Above all the invention of artificial fertilizers influenced the cultivation of the former *Bourtanger Moor* importantly, because the turf cutting could move on after the 1920's in the prospect of rather simple cultivation into agriculture land. Non of these circumstance played a role in the *Smildervenen.*
2. In modern studies strict geographical demarcations are no longer used. Economic, social, cultural, political and ecological borders do not always fit in the same geographical space. Today they are seen as layers with an autonomous development. The role of the city of Groningen for example cannot be fully understood if only judged within the borders of the inland socio-ecological system. If the concept of socio-ecological system is used, this problem needs more attention.
3. Most studies about peatlands try to analyze the social and economic developments.

There is surprisingly low interest for the mental reflection on bogs. But just these reflections can learn us more about the ecological place of these bogs in the environmental thinking of farmers. Especially interesting is to compare the mental conception of the farmers in the older village on sandy soil and those peasants that colonized in the pre-modern times the *Bourtanger Moor*, for example the German farmers around *Twist* (18^{th}-20^{th} centuries). But also the development of bogs from wastelands into protected parks (*Bargerveen* and *Fochteloërveen*) tells something about the changing mental conception about these areas.

4. There are a few historical-ecological studies of Drenthe. One good example is Hans Elerie's study of the *Reestdal*. (Elerie 1998). The starting point of these studies is mostly the social environment of farmers. But these micro history studies also give good insight how farmers used their ecological environment. Bieleman (1987), who wrote an impressive thesis about Drenthe's agricultural development from 1600 until 1900, pays little attention to cultivate moor lands. This is not intended as a reproach, – he tried to reconstruct the agriculture on sandy soil – but to show that here is still a gap in research. Studies about cultivations at the edge of the moors and about settlements of colonists in the high moors are necessary.
5. Local historians often know the regulations of the villages regarding the bogs. Were farmers allowed to cultivate the edges of the moor? Who was allowed to use the dry parts of the moor lands for their cattle? Just a few questions on which the answers differed from villages to village. The local knowledge of these regulations has never been collected and analyzed in a comparative study. Not only should the local regulations be compared, but also the influence of regulations by the central government on local circumstances. Further research is desired.
6. The social and economic developments of the inland socio-ecological system have been extensively researched. Additional studies are still necessary. Partly these coincide with the ones mentioned by point 4.

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